

# **Lecture**

## **Module 12: Disturbance Ecology**

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### **Learning Objectives**

Upon completion of this module, the participant will be able to:

1. Describe the major types of ecological disturbances and how they influence site potential, productivity, and sustainability.
2. Describe the role of disturbance in ecosystem structure and function.
3. Describe the difference between ecological disturbances and perturbations.
4. Describe how perturbations and disruption of natural disturbance regimes influence ecosystems.
5. Describe resource management and ecosystem restoration options using disturbance.

***The closer an ecosystem is managed in harmony with those processes in which it evolved, the more successful that management strategy will be.***

James Lotan 1981

### **Lecture Outline**

Disturbance

Definition

Types

Spatial and temporal considerations

Ecosystem wide effects

Perturbation

Stress

Disturbance regimes

Fire

Flood

Disturbance and land management

Consequences of altered disturbance regimes

Ecological restoration



## Exercises

### Quantification/description of disturbances or perturbations and ecosystem adaptations.

Go to a field, forest, wetland complex, grassland, shrubland, woodland, or floodplain. Hike through the area observing and recording as much of the natural history as you can. Pay particular attention to those features that may tell you something of the perturbation or disturbance history of the area. NOTE: If a field trip is not possible, trainers should have a packet of aerial photos and current on-the-ground landscape photos available for students to use to complete this exercise. The following link can be used to obtain aerial photographs and other landscape information.

[http://edcwww.cr.usgs.gov/Webglis/glisbin/finder\\_main.pl?dataset\\_name=NAPP](http://edcwww.cr.usgs.gov/Webglis/glisbin/finder_main.pl?dataset_name=NAPP)

**Look for the following characteristics of the site, either as you walk through it or view photos of it:**

- Age structure of vegetation
- Fire scars or evidence of other disturbances, such as blow-down
- Evidence of and extent of soil compaction
- Plant species composition - plant adaptations, successional status.
- Presence of snags, dead shrubs, dead or downed wood, etc.

### Evaluate the following:

#### 1. *Ecosystem patch dynamics*

- Patch size and vegetation composition, age class, and structure. Are there multiple or single age classes? Hike through a sizable area of at least 3 acres (or study a large area using aerial photos).
- Connectivity of vegetation

#### 2. *Species composition*

- Overstory and understory plant species- how many species are present? Are there any exotic species present? What is the percentage of exotic species relevant to native species?
- Describe any plant adaptations to the disturbance (fire, flood, etc.) or perturbation.
- List any wildlife and insects present

*3. Physical attributes of the site*

- Determine slope, aspect topography, position on the slope and how the vegetation varies.

*4. Apparent and recent past disturbances*

Fire, wind, disease, herbivory, humans- how do these interact? Can you determine the long-term effects of altering natural disturbance patterns in this area?

**Describe the area that you visited using the relevant information collected above.**

- What is the current and historical disturbance regime?

- Describe what you saw, and make interpretations of your observations of disturbances.
- How have current and past disturbances influenced vegetation structure and species composition?
- How have human activities directly and indirectly influenced the disturbance regime?
- What might be required for ecosystem restoration?

Use web sources when possible. For example, go to the Fire Effects Information System and gather the summary data for at least 5 plant species and 3 fish/wildlife species that you observed or know to be present. Work with other classmates on this. Collaboration is a must.

The Fire effects information system: <http://www.fs.fed.us/database/feis/plants>

Information about your specific watershed that may be helpful when considering restoration actions: <http://www.epa.gov/surf/>

## **Study Questions**

1. Disturbances such as floods and fire generally affect entire ecosystems or landscapes. How might human perturbations at local scales alter disturbance regimes and thus have short and long-term affects on the site?
2. Explain the difference between disturbance and perturbation.
3. Explain the role disturbance plays in land management.

## References and Selected Reading

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*Slides used in lecture*

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## Disturbance

Periodic disturbances in forests, shrublands, grasslands, and wetlands are part of the natural environment; as natural of an environmental factor as snow, wind, or rain.

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## Ecological Disturbance

Any discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrates, or the physical environment.

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## Disturbances include:

- Floods
- Wildfire
- Ice flows
- Hurricanes
- Wind and ice storms



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### Scales of disturbance

Natural disturbances occur on a wide variety of spatial and temporal scales.

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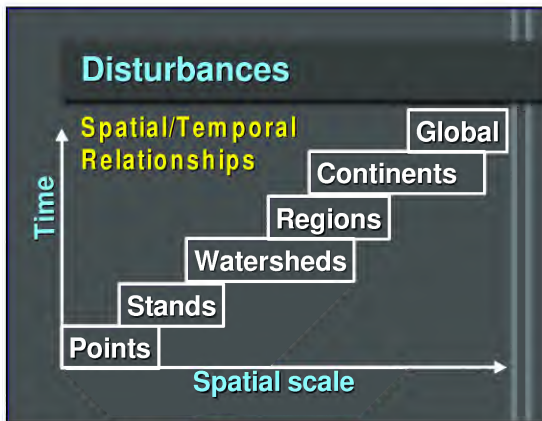
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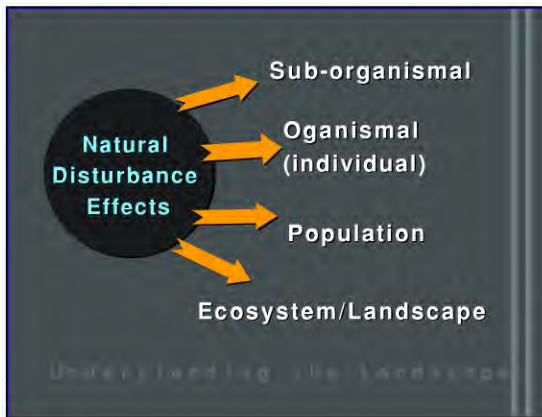
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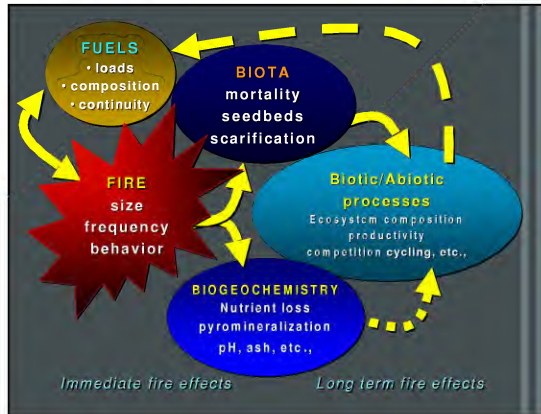
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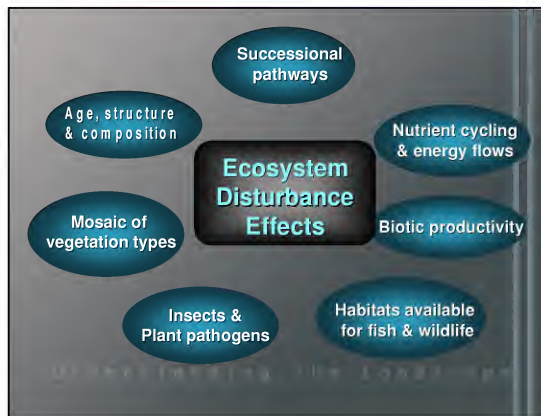
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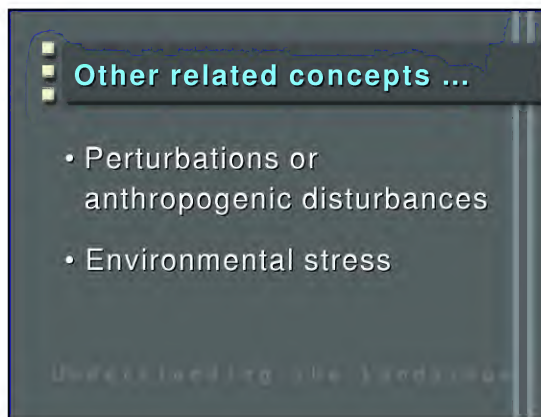
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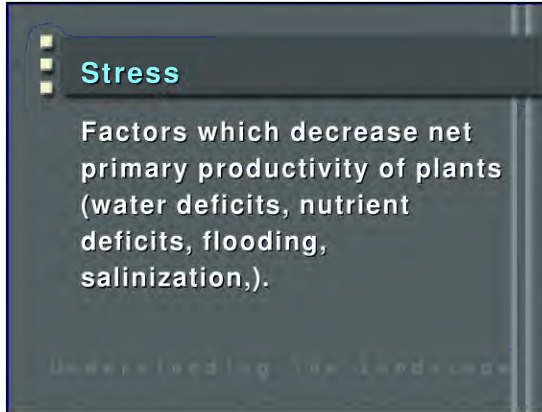
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A presentation slide with a dark background and light text. The title "Stress" is in a larger, bold font. Below it, a paragraph defines stress as factors that decrease net primary productivity of plants, listing water deficits, nutrient deficits, flooding, and salinization. At the bottom, there is a faint text "Understanding the Landscape".

**Stress**

Factors which decrease net primary productivity of plants (water deficits, nutrient deficits, flooding, salinization,).

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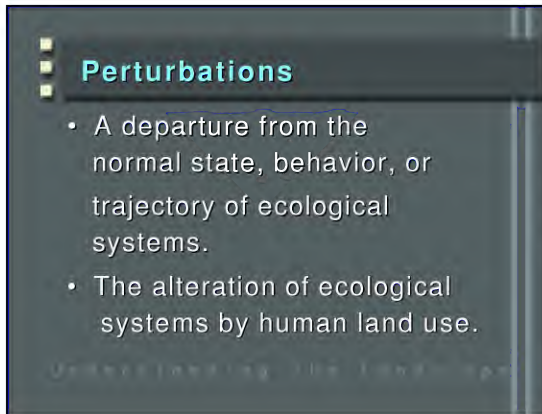
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A presentation slide with a dark background and light text. The title "Perturbations" is in a larger, bold font. Below it, a bulleted list defines perturbations as a departure from the normal state, behavior, or trajectory of ecological systems, and the alteration of ecological systems by human land use. At the bottom, there is a faint text "Understanding the Landscape".

**Perturbations**

- A departure from the normal state, behavior, or trajectory of ecological systems.
- The alteration of ecological systems by human land use.

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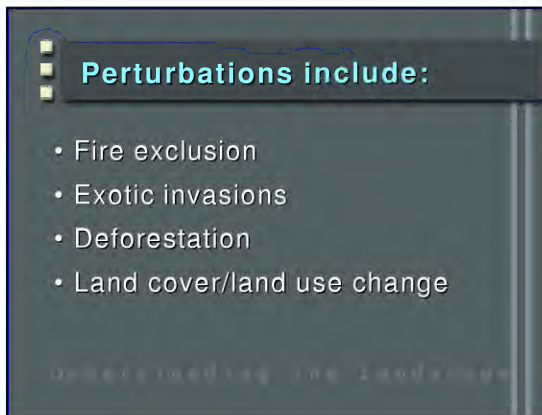
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**Perturbations include:**

- Fire exclusion
- Exotic invasions
- Deforestation
- Land cover/land use change

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**Perturbations include:**

- Introduction of non-native herbivores-overgrazing
- Water diversions- altering natural hydro-dynamics
- Channelization
- Pollution

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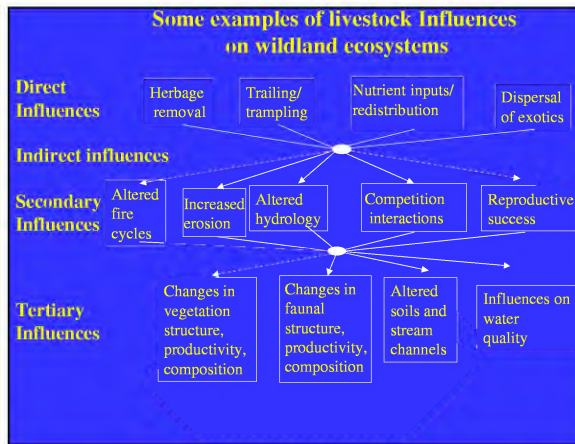
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**Disturbance Regimes:**

The general pattern or occurrence of a disturbance in a given ecosystem.

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**Disturbance Regimes:**

**Defined by:**

- Frequency
- Size
- Magnitude
- Severity and intensity

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**Example: Fire Regimes**

- Low severity
  - Frequent low intensity surface fires
- Moderate severity
  - Frequent, low intensity surface fires and infrequent stand-replacing fires
- High severity
  - Infrequent (long return interval) severe, stand-replacing fires.

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**High Severity regime**



- Long return interval
- Stand replacing fires
- Usually large in area

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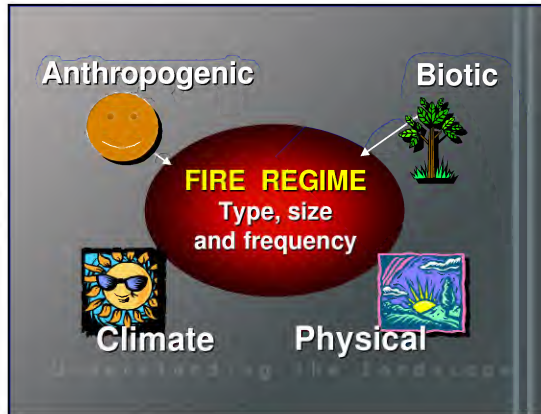
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### Floods

Floods occur when flows fill an alluvial channel at bankfull discharge.

Significant substratum movement occurs (suspended sediment as well as bed load transport).

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### Flood Regime Variables

- Frequency
- Magnitude
  - (2, 5, 50, 100 year floods)
- Season
- Duration

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**Disturbance processes are important in land management...**

- Critical to maintain productivity and biodiversity
- Negative consequences arise from altering disturbances
- Disturbances are a part of ecological restoration

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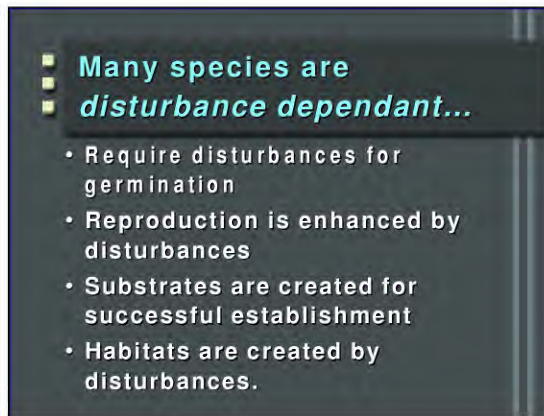
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**Many species are disturbance dependant...**

- Require disturbances for germination
- Reproduction is enhanced by disturbances
- Substrates are created for successful establishment
- Habitats are created by disturbances.

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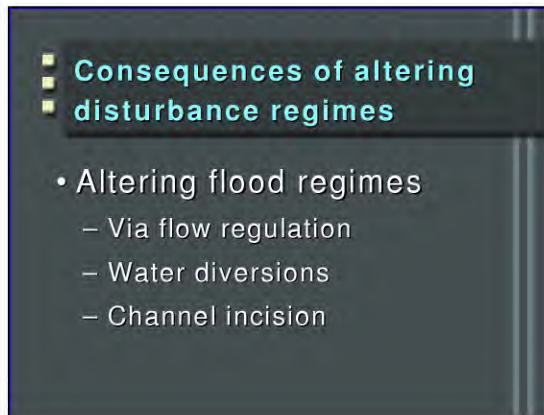
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**Consequences of altering disturbance regimes**

- Altering flood regimes
  - Via flow regulation
  - Water diversions
  - Channel incision

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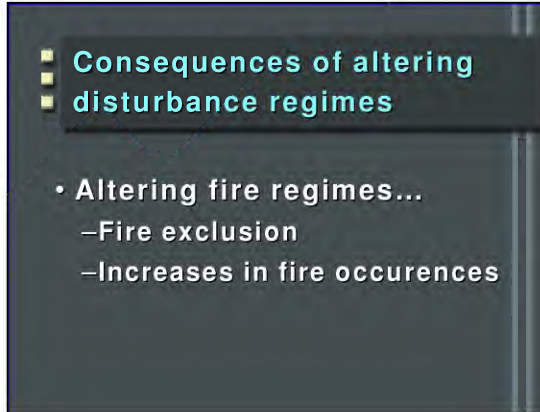
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■ **Consequences of altering disturbance regimes**

- Altering fire regimes...
  - Fire exclusion
  - Increases in fire occurrences

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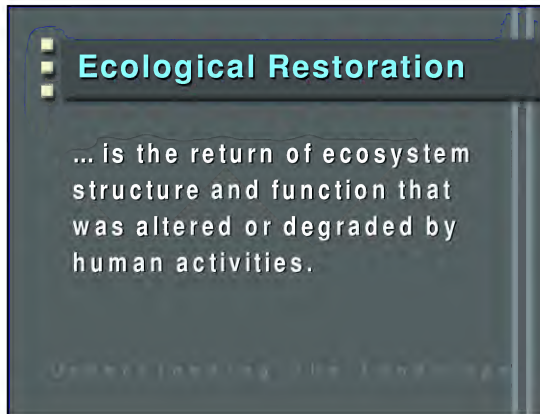
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■ **Ecological Restoration**

... is the return of ecosystem structure and function that was altered or degraded by human activities.

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■ **Ecological Restoration**

Involves the re-establishment of ecosystem features to the bounds of their range of natural variability

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### Ecological Restoration

Includes the restoration of disturbances (fires, floods, etc.) within their natural regime.

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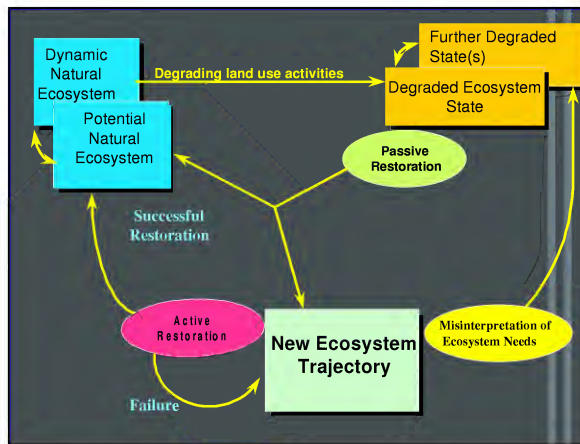
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From a biological and ecological perspective, the only known substitute for natural fire, and the infinite and complex processes that arise from fire, is **prescribed burning**

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